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(54) Portable apparatus having a flat panel type display unit.

(57) A portable computer (1) has a keyboard (6) and a display unit (3) mounted to a base unit (2). The base unit (2) is equipped with a battery (8) for generating a reference voltage. The display unit (3) has a plasma display (20) and a housing (22) for containing the plasma display (20). This housing (22) is rotated to an open position for permitting visual confirmation of plasma display (20) at the time of display an image. In the housing (22) of the display unit (3) is retained a voltage converter (42) for converting the reference voltage of the battery (8) into a drive voltage for driving the plasma display (20). The voltage converter (42), which self-generates heat during its converting operation, is arranged on the right or left of the plasma display (20) rotated to the open position or above the plasma display (20).

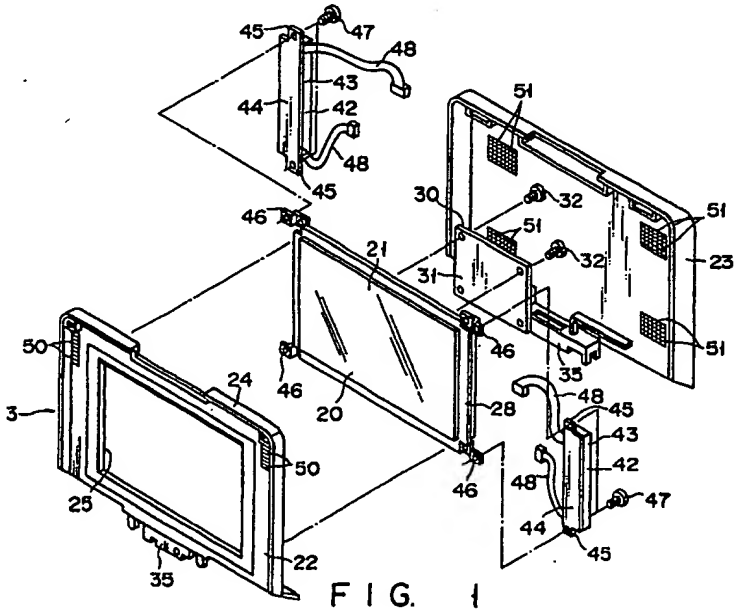

FIG. 1

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PORTABLE APPARATUS HAVING A FLAT PANEL TYPE DISPLAY UNIT

The present invention relates to a portable apparatus, such as a laptop type or portable type computer having a flat panel type display unit mounted detachable to a base unit. More particularly, this invention relates to a structure of a display unit having a voltage converter built therein.

Recently, laptop type computers are popular which have a keyboard and a flat panel type display unit mounted to a base unit having a rectangular box shape.

Of portable computers of this type, the one having a display unit with a liquid crystal display (LCD) detachably connected to a base unit is disclosed in U S P 4.749.364. According to the computer with the detachable display unit, when an image with a high resolution is desired, an operator detaches the display unit from the base unit and connects a CRT display unit to the base unit by a cable.

With this portable computer in use, to connect the display unit detachably, a socket having first connector is provided to the base unit. The display unit has an engage leg having a second connector in association with this socket. Plugging the engage leg into the socket connects the connectors together to thereby mechanically and electrically couple the base unit and display unit.

The display unit uses a battery on the base unit side as its driving power supply. In a case where an LCD with a back light or plasma display is employed in the display unit, burning on the back light or generating a plasma discharge requires a voltage converter to convert the reference voltage of the battery into a high voltage. When this voltage converter is located on the base unit side, the first connector in the socket receives a high voltage through the voltage converter. The first connector, which is applied with the high voltage, is exposed in the socket when the display unit is detached from the socket. The operator, when accidentally touches the first connector, probably receive an electric shock.

According to computers with a detachable display unit, it is desired that the voltage converter be attached to the display unit side as disclosed in U.S. Patent Application Serial No. 07/406,614 filed September 12, 1989 by Takashi Hosoi.

The voltage converter includes circuit parts, such as a transformer and resistors, which generate heat themselves while being energized. Accommodating the voltage converter in the housing of the display unit therefore raise the following problem:

When using the computer, the operator sets the display unit upright for easier view of the LCD. If the voltage converter is located below the LCD when the display unit stands upright, heat generated by circuit parts rises due to the convection in the housing and is locally transmitted to the LCD. This produces color spots on the display screen due to the temperature difference, making it difficult to see an image.

It is an object of the present invention to provide a portable apparatus which hinders heat generated by a circuit parts from being transmitted to display means, thus ensuring display of an image with a high resolution.

To achieve the object, according to the present invention, there is provided a portable apparatus comprising:

a base unit having power supply means for generating a reference voltage;

a display unit supported rotatable to the base unit, having flat panel display and a housing for containing the flat panel display, the housing being rotated to an open position for operating the apparatus; and

means, electrically connected to the power supply means, for converting a reference voltage of the power supply means into a drive voltage for driving the flat panel display, the converting means being located on the right or left of the flat panel display rotated to the open position or thereabove in the housing.

According to the portable apparatus of this invention, when the display unit is set upright, the converting means is not located below the flat panel display. Therefore, the flat panel display is prevented from being directly exposed to heat from the converting means that rises in the housing to thereby reduce the heat influence on the flat panel display, irrespective of the flat panel display and the converting means being located in the same housing.

This invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is an exploded perspective view of a display unit of a portable computer according to the present invention;

Fig. 2 is a partly cutaway front view of the display unit shown in Fig. 1;

Fig. 3 is a perspective view illustrating the display unit of the portable computer in an upright state;

Fig. 4 is an exploded perspective view illustrating the display unit of the portable computer in Fig. 3 being detached from a base unit;

Fig. 5 is a cross sectional view illustrating a

connecting portion of the display unit being detached from the base unit;

Fig. 6 is a cross sectional view taken along line A-A in Fig. 5;

Fig. 7 is a cross sectional view illustrating a portion where the connecting portion of the display unit being coupled to a socket of the base unit;'

Fig. 8 is a perspective view showing the display unit of the portable computer in a closed state;

Fig. 9 is a partly cutaway front view illustrating a display unit according to the second embodiment of the present invention; and

Fig. 10 is a front view showing a display unit according to the third embodiment of the present invention.

Fig. 3 illustrates a laptop type portable computer 1. The computer 1 has a base unit 2 and a flat panel type display unit 3. The base unit 2, which is shaped like a thin rectangular box, comprises a bottom case 4 and a top cover 5 that covers the top of the bottom case 4. The top cover 5 has a front portion 5a attached with a keyboard 6. A rear portion 5b of the top cover 5 is thicker than the front portion 5a. A pair of battery receiving recesses 7 are provided side by side at the back of the rear portion 5b. A battery 8 as a driving power supply for the computer 1 is detachably attached to each recess 7. The battery 8 is electrically connected to a printed circuit board (not shown) located in the base unit 2.

A socket mounting recess 10 is provided at the center portion of the front end of the rear portion 5b. As shown in Fig. 4 to 6, the recess 10 has two side walls 10a and 10b and a bottom 10c extending between the side walls 10a and 10b. A box-shaped socket 11 is mounted in the recess 10. The socket 11 has an opening portion 12 for detachable connection of the display unit 3. The socket 11 also has two side portions 13a and 13b respectively facing the side walls 10a and 10b of the recess 10, and each of the side portions 13a and 13b is supported rotatable on the top cover 5 by a hinge mechanism 14. The hinge mechanism 14, located inside the top cover 5. The hinge mechanism 14 has a hinge shaft 15 that rotates around the shaft. The hinge shaft penetrates the side walls 10a and lob 10b the socket mounting recess 10 and the side portions 13a and 13b of the socket 11, and is connected rotatable to the top cover 5. The free rotation of the hinge shaft 15 is suppressed by spring means (not shown). The one end of the hinge shaft 15 is extends into the socket 11, and an engage piece 16 is formed at this one end of the hinge shaft 15.

A first connector 17, which is retained in the socket 11, is electrically connected to the printed circuit board in the base unit 2 by a cable 18.

A display unit 3 to be coupled detachable to the socket 11 has a plasma display 20 for displaying an image. The plasma display 20 includes a rectangular screen 21, and is retained in a housing 22 with a rectangular box shape. As shown in Fig. 1, the housing 22 comprises a rear panel 23 and a front panel 24 connected together. The plasma display 20 is held between both panels 23 and 24. An opening 25 for exposing the screen 21 is formed in the center portion of the front panel 24. This housing 22 has space 26 on either side of the opening 25.

As shown in fig. 1, the plasma display 20 has a frame 28 made of aluminum alloy. The frame 28 has a rectangular flat shape greater than the size of the screen 21. The frame 28 has four corner portions securely fastened to the inner wall of the rear panel 23 by screws 29. A drive circuit portion 30 for driving the plasma display 20 is located between the frame 28 and rear panel 23. This drive circuit portion 30 includes various circuit parts, such as IC and connectors, which are mounted on a printed circuit board 31. The printed circuit board 31 is securely fastened through screws 32 to the frame 28.

As shown in Fig. 4, the housing 22 of the display unit 3 has a connecting portion 35 which is connected detachable to the socket 11. The connecting portion 35 is positioned at the lower center portion of the housing 22 and has a box shape fittable in the socket 11. A metal engaging leg 36 is provided on either side of the connection portion 35. As shown in Fig. 6, an engage groove 37 is formed in the end of the engaging leg 36. The engage groove 37 engages with the engage piece 16 of the hinge shaft 15 when the connecting portion 35 of the housing 22 is fitted in the socket 11. This engagement permits the display unit 3 to rotate together with the hinge shaft 15 therearound. Accordingly, the display unit 3 is rotated between the close position where the keyboard 6 is covered and the open position where the keyboard 6 is exposed when displaying an image and the screen 21 can be visually confirmed, as indicated by the arrow X in Fig. 3.

The engaging leg 36 is provided with a tongue 38 protruding from the front of the connecting portion 35. A screw (not shown) which penetrates the front of the socket 11 is screwed into the tongue 38, and this screw prevents the connecting portion 35 from coming off of the socket 11. A second connector 40 is retained inside the connecting portion 35. The second connector 40 is electrically connected to the drive circuit portion 30 through a cable 41. Plugging the connecting portion 35 of the housing 22 into the socket 11 electrically connects the second connector 40 to the first connector 17. This electric connection permits

the display unit 3 to be electrically connected to the base unit 2.

The display unit 3 includes a voltage converter 42 which is electrically connected by a cable 48 to the drive circuit portion 30 and the second connector 40.

The voltage converter 42 is supplied with a reference voltage V1 of the battery 8 through the first and second connectors 17 and 40. The voltage converter 42 converts the received reference voltage V1 into a drive voltage V2 for driving the plasma display 20. The drive circuit portion 30 of the plasma display 20 is driven by the drive voltage V2.

This voltage converter 42 is located together with the plasma display 20 in the housing 22 of the display unit 3. The voltage converter 42 includes a circuit parts 43, such as a capacitor or a transformer, which self-generates heat during the converting operation. As shown in Figs. 1 and 2, the circuit parts 43 is separated into two portions which are respectively mounted on a pair of printed circuit boards 44. The printed circuit boards 44 have an elongated shape to be consistent with both side portions of the frame 28 of the plasma display 20. Tongues 45 are provided at the respective lengthwise end portions of the printed circuit board 44. The tongues 45 are securely fastened by means of screws 47 to brackets 46 of the corner portions of the frame 28. The securing of the tongues 45 in this manner sets the circuit parts 43, which self-generates heat, on both sides of the plasma display 20, and to be retained in the spaces 26 in the housing 22.

Air holes 50 of a louver shaper open to the spaces 26 in the housing 22 are formed at four sections of the front panel 24 of the housing 22. With the display unit 3 rotated to the open position, the air holes 50 are located on both right and left sides of the upper front portion of the front panel 24 and on right and left sides of the bottom of the front panel 24. When the display unit 3 stands upright, therefore, the individual air holes 50 respectively face the upper and lower ends of the printed circuit board 44 that support the circuit parts 43. Other air holes 51 open to the interior of the housing 22 are also formed in the rear panel 23 of the housing 22. The air holes 51 are located at four corners of the rear panel 23, communicating with the spaces 26 in the housing 22. Like the air holes 50, therefore, the air holes 51 respectively face the upper and lower ends of the printed circuit board 44 that support the circuit parts 43 when the display unit 3 is at the open position.

When the circuit parts 43 of the voltage converter 42 generates heat during the use of the computer 1, the temperature in the housing 22 rises, causing a convection in the housing 22. As a result, the outside air flows into the spaces 26 in the housing 22 through the air holes 50 and 51 formed in the lower portions of the front panel 24 and the rear panel 23. The outside air rises in the spaces 26 in the housing 22 by the convection, and contacts the printed circuit board 44 and the circuit parts 43 to cool them in the course of the rising action. Having cooled the circuit parts 43 and printed circuit board 44, the outside air is discharged outside of the housing 22 through the air holes 50 and 51 at the upper portions of the front panel 24 and rear panel 23. Accordingly, the air permeability in the spaces 26 in the housing 22 is improved, preventing the heat of the circuit parts 43 from remaining in the housing 22. The housing 22 of the display unit 3 is provided with a latch piece 53 for holding the display unit 3 at the close position. This latch piece 53 extends from the front of the front panel 24 of the housing 20. With the display unit 3 closed at the close position, the extending portion 53a of the latch piece 53 engages with an engage recess 54 at the front of the bottom case 4 to thereby hold the display unit 3 at the close position.

According to the portable computer 1 with the above arrangement, the voltage converter 42, which self-generages heat during the converting action, is arranged on the right and left of the plasma display 20 in the housing 22 of the display unit 3. Even with the display unit 3 rotated to the open position for image display, therefore, the voltage converter 42 does not come under the plasma display 20. Therefore, the heat generated from the voltage converter 42 does not rise in the spaces 26 in the housing 22 in such a way as to surround the plasma display 20. As a result, the heat influence on the plasma display 20 is reduced even though the plasma display 20 and the voltage converter 42 are located in the same housing 22.

Further, while the computer 1 is in use, the heat generated by the circuit parts 43 escapes out of the housing 22 through the air holes 50 and 51 of the rear panel 23 and front panel 24, thus preventing the temperature in the housing 22 from locally increasing.

The difference in temperature at the individual sections of the plasma display 20 gets smaller, permitting an image with fewer color spots and higher resolution to be displayed.

Fig. 9 illustrates the second embodiment of the present invention. The second embodiment differs from the first embodiment in that a display unit 60 employs a back-light type liquid crystal display 61 in place of the plasma display 20. As disclosed in U.S. Patent Application Serial No. 07/514,027 filed April 27, 1990 by Seiichi Furuya, the voltage converter 42 of the display unit 60 using the liquid crystal display 61 converts the reference voltage

V1 of the battery 8 into a drive voltage V3 for driving the back-light device. The drive circuit portion of the liquid crystal display 61 is driven by the reference voltage V1 of the battery 8.

The circuit parts 43 constituting the voltage converter 42 is mounted on a single elongated printed circuit board 62, which is located along the right side of the liquid crystal display 61. The printed circuit board 62 is securely fastened to a frame 63 of the display 61 by means of screws 64.

The display unit 60 is provided with a dial 66 for controlling the display density of a display screen 65 and a dial 67 for controlling the brightness of the display screen 65.

Fig. 10 illustrates the third embodiment of the present invention. The third embodiment differs from the first embodiment in that the housing 22 rotated to the open position has a space 71 above the opening 25, with the voltage converter 42 arranged in this space 71. The fundamental structure and action, except the location of the voltage converter 42, are the same as those of the first embodiment.

The portable apparatus according to the present invention should not necessarily be restricted to a laptop type portable computer, but the present invention may be applied to a word processor or a liquid crystal television as well.

Claims

1. A portable apparatus comprising a base unit (2) having power supply means (8) for generating a reference voltage, a display unit (3, 60) supported rotatable to the base unit (2), having flat panel display (20, 61) and a housing (22) for containing said flat panel display (20, 61), said housing (22) being rotated to an open position for operating the apparatus, and means (42), electrically connected to said power supply means (8), for converting a reference voltage of said power supply means (8) into a drive voltage for driving said flat panel display (20, 61), characterized in that said converting means (42) is located on the right or left of said flat panel display (20, 61) rotated to said open position or thereabove in said housing (22).

2. The portable apparatus according to claim 1, characterized in that said flat panel display (20) of said display unit (3) is a plasma display (20).

3. The portable apparatus according to claim 1, characterized in that said flat panel display (61) of said display unit (3) has a transmission type liquid crystal display (61) and back-light device.

4. The portable apparatus according to claim 1, characterized in that said housing (22) of said display unit (3) has an opening (25) for exposing said flat panel display (20, 61) and space (26) on either side of said opening (25) for retaining said converting means (42).

5. The portable apparatus according to claim 1, characterized in that said converting means (42) includes a pair of elongated printed circuit boards (44) arranged on right and left sides of said flat panel display (20).

6. The portable apparatus according to claim 4, characterized in that said housing (22) of said display unit (3) includes a rear panel (23) and a front panel (24) attached to said rear panel (23), with said flat panel display (20, 61) and converting means (42) being held between said front and rear panels (23, 24), said front panel (24) having an opening (25) provided therein.

7. The portable apparatus according to claim 6, characterized in that said flat panel displhy (20, 61) includes a frame (28, 63) of an aluminum alloy attached to said rear panel (23).

8. The portable apparatus according to claim 7, characterized in that said printed circuit boards (44) of said converting means (42) are mounted on right and left side portions of said frame (28).

9. The portable apparatus according to claim 6, characterized in that air holes (50, 51) respectively communicating with said spaces (26) in said housing (22) are formed in said front and rear panels (23, 24) of said housing (22) at positions corresponding to said printed circuit boards (44).

10. The portable apparatus according to claim 9, characterized in that said air holes (50, 51) face upper and lower end portions of said printed circuit boards (44) when said display unit (3) is rotated to said open position.

11. The portable apparatus according to claim 1, characterized in that said power supply means (8) is a battery (8) detachably mounted to said base unit (2).

12. The portable apparatus according to claim 1, characterized in that said base unit (2) has a keyboard (6) at a front portion, and said display unit (3) is rotatable to any position between a close position for covering said keyboard (6) and said open position.

13. A portable apparatus comprising a base unit (2) having power supply means (8) for generating a reference voltage, a socket (11) supported pivotable to said base unit (2) by hinge means (14), a display unit (3) includes a connecting portion to be detachably connected to said socket (11), having display device (20, 61) and a housing (22) for containing said display device (20, 61), said connecting portion to be connected to said socket (11) being provided on said housing (22), said housing (22) being rotated to an open position for operating the apparatus, and means, electrically connected to said power supply means (8), for converting a reference voltage of said power supply means (8)

into a drive voltage for driving said display device (20, 61), characterized in that said converting means (42) being located on the right or left of said display device (20, 61) rotated to said open position or thereabove in said housing (22).

14. The portable apparatus according to claim 13, characterized in that said socket (11) has a first connector (17) electrically connected to said power supply means (8), said connecting portion (35) of said display unit (3) has a second connector (40) electrically connected to said converting means (42) and said display device (20, 61), and said first and second connectors (17, 40) are electrically connected together when said connecting portion (35) is coupled to said socket (11).

15. The portable apparatus according to claim 13, characterized in that said base unit (2) has a keyboard (6) at a front portion and a socket-mounting recess (10) formed at a rear portion, for receiving said socket (11).

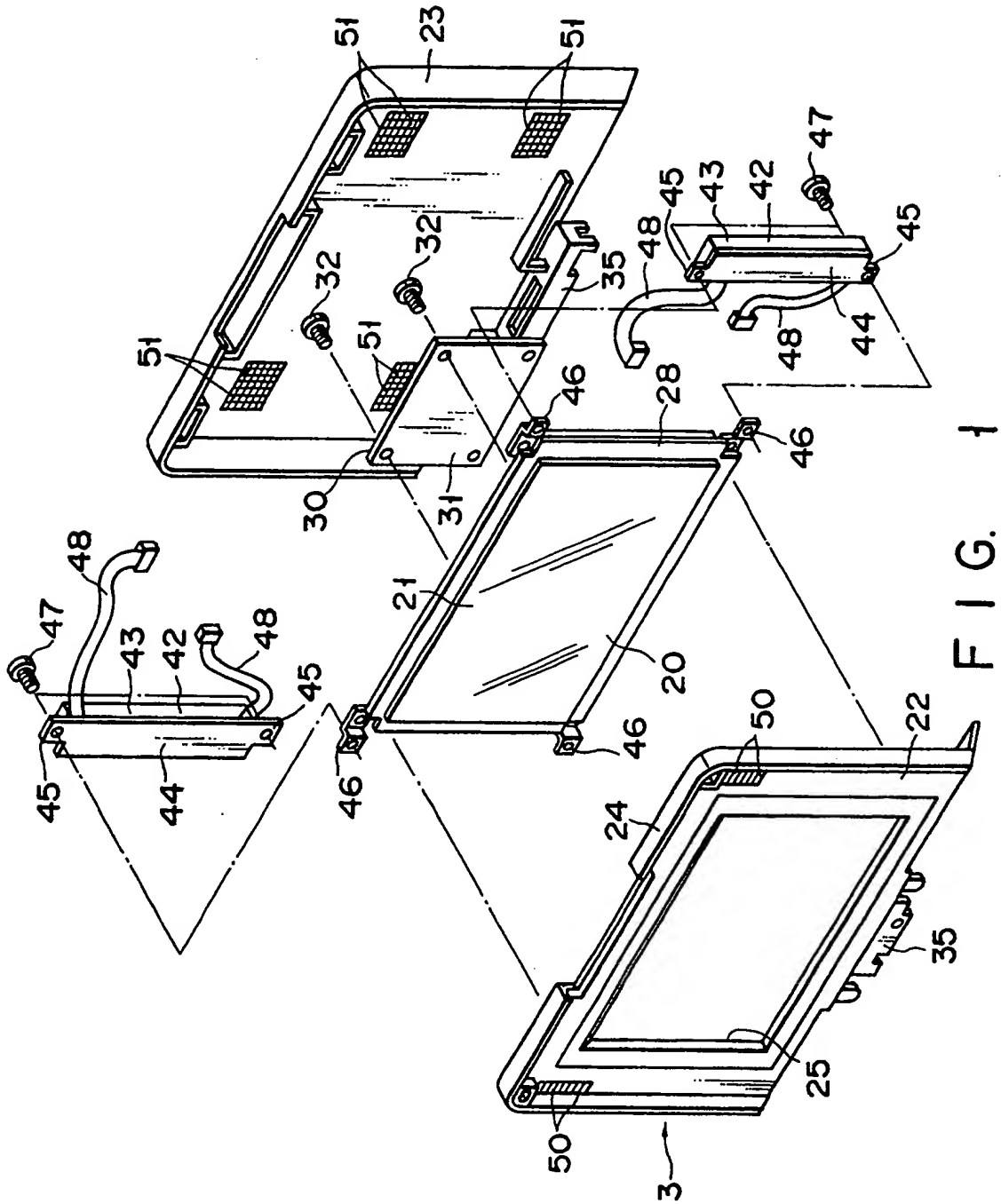
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FIG. 1

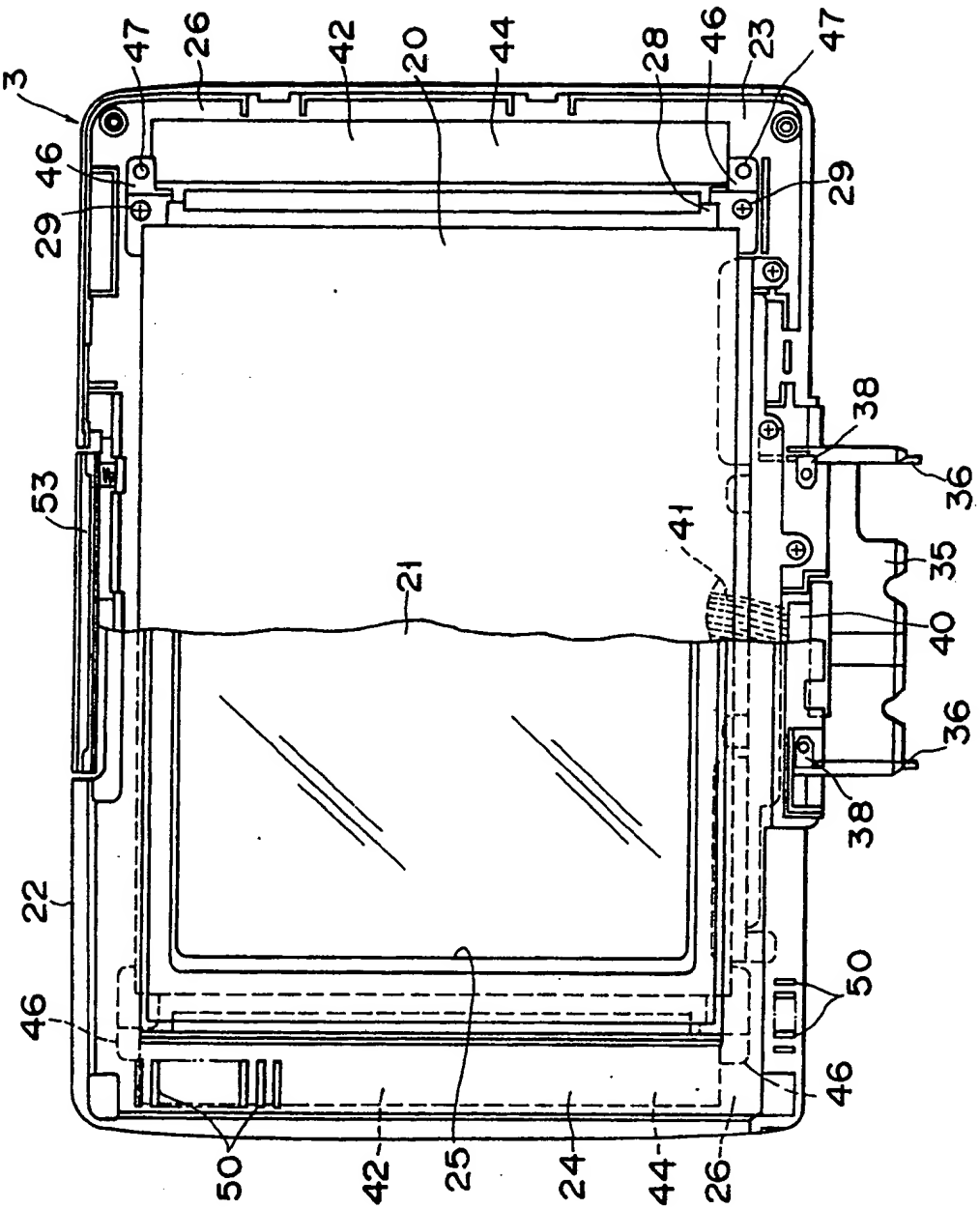
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FIG. 2

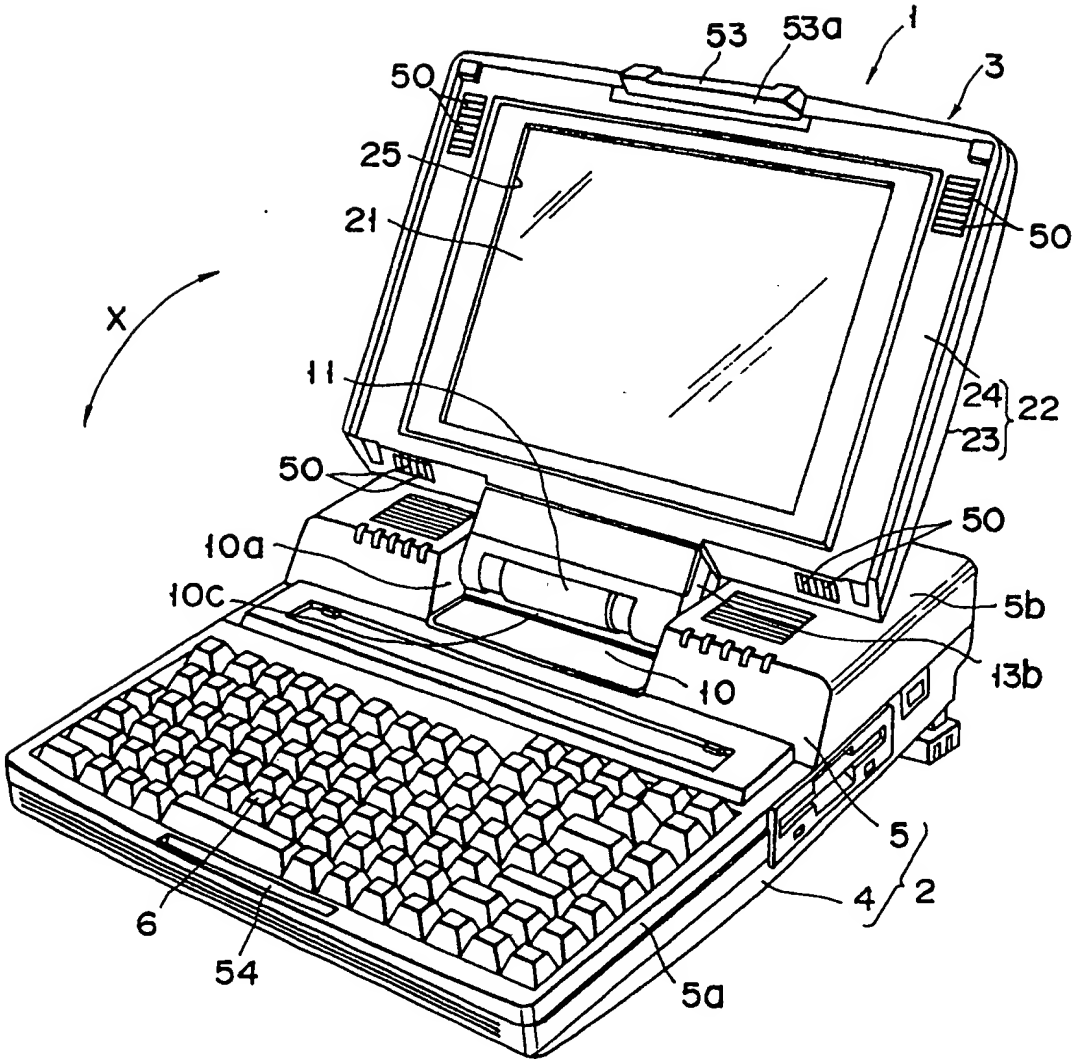

FIG. 3

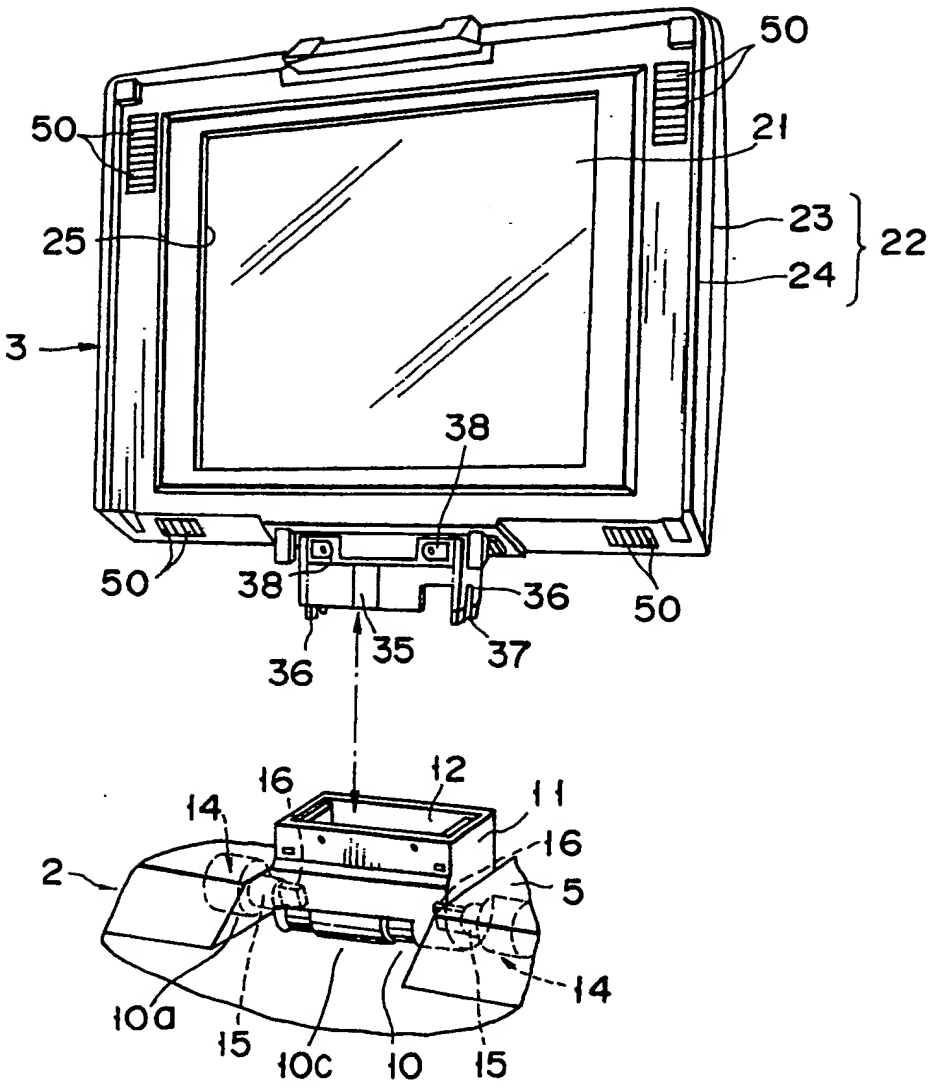
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FIG. 4

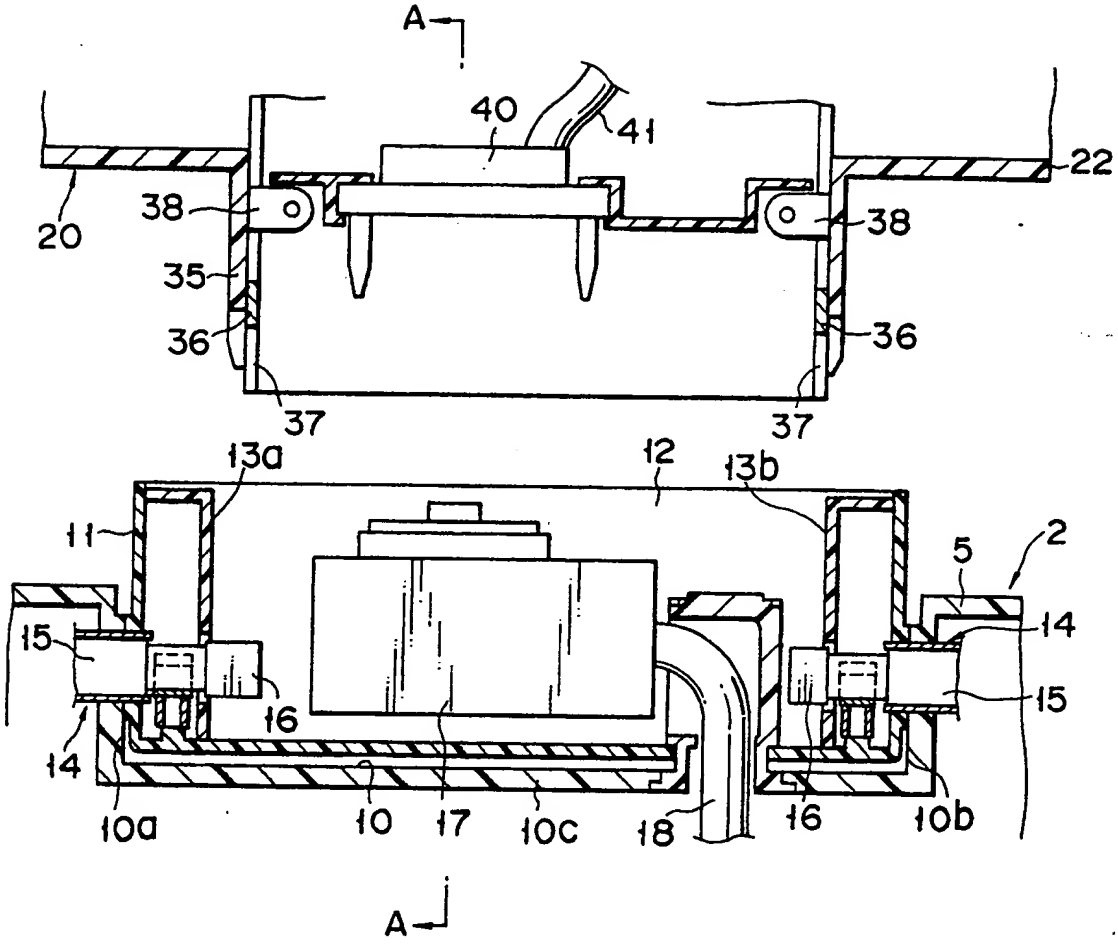
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FIG. 5

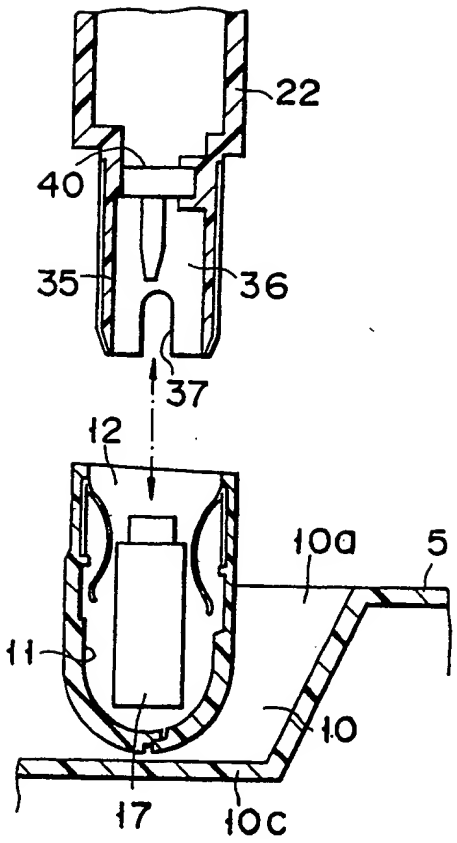

FIG. 6

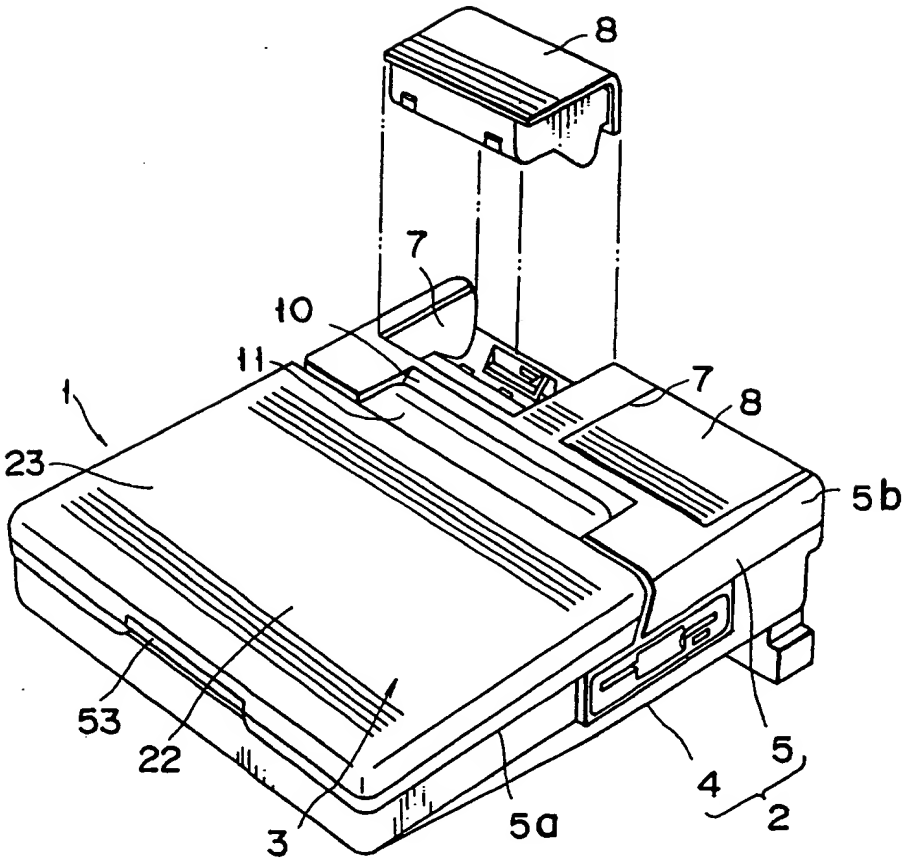

FIG. 8

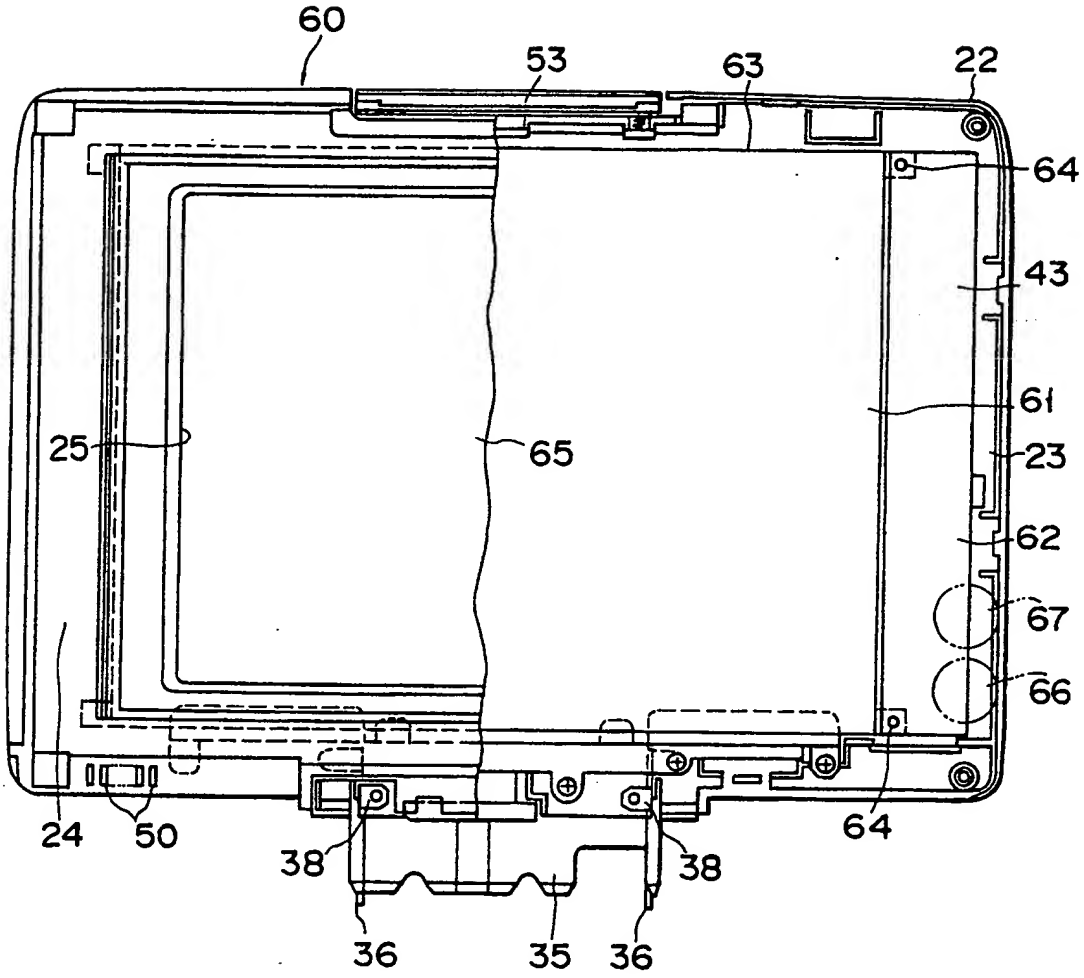

FIG. 9

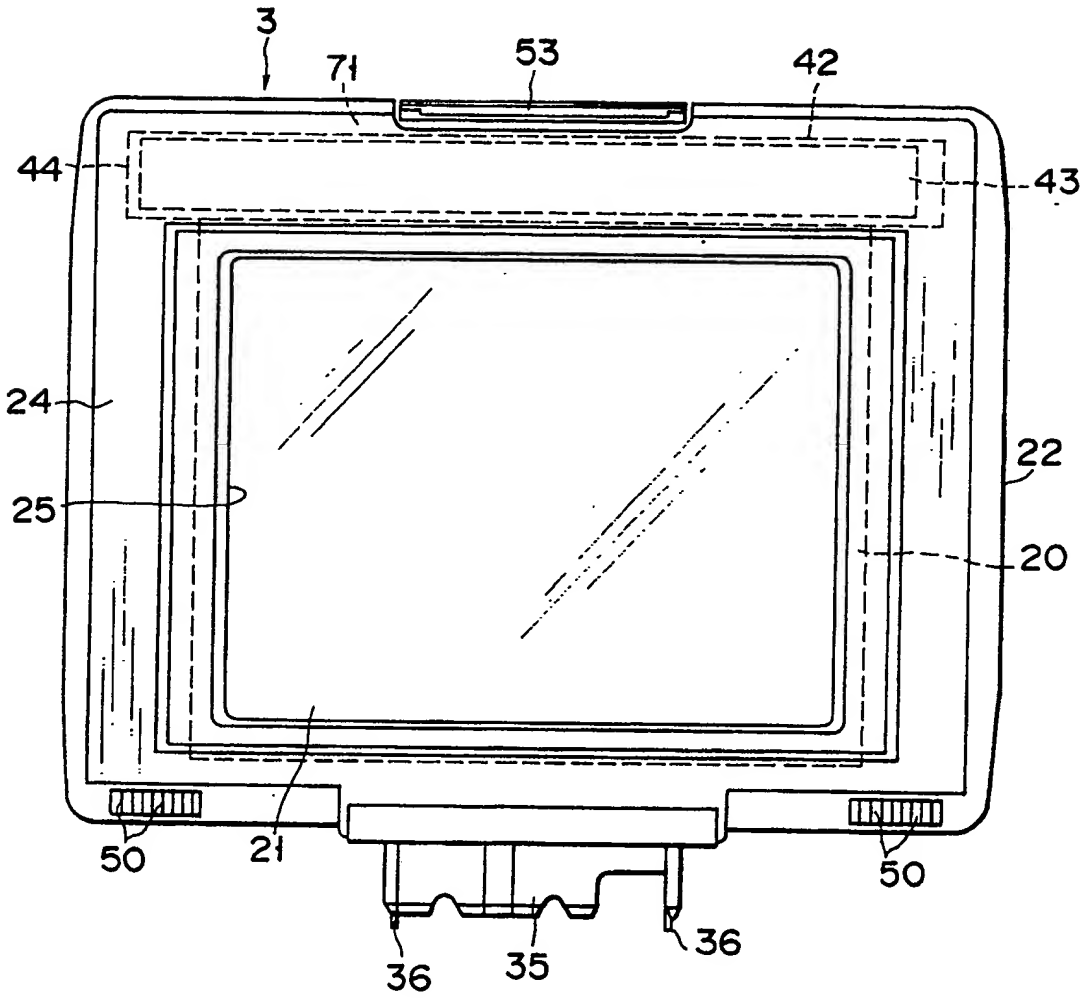

FIG. 10